Additions to the Late Pleistocene Vertebrate Paleontology of the Las Vegas Formation, Clark County, Nevada

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ABSTRACT

Studies from the 1930s through the 1960s documented one of the most significant late Pleistocene faunas from the Mojave Desert in the Tule Springs area of North Las Vegas. Recent field investigations in North Las Vegas by the San Bernardino County Museum have broadened our knowledge of this fauna across the Las Vegas Wash.Seven units, designated A through G, have been defined in the section of the Las Vegas Wash near Tule Springs State Park. Units B, D, and E have proven fossiliferous in the area of the Tule Springs State Park, and date to>40,000 ybp, approximately 25,500 ybp, and about 14,500 to 9,300 ybp,respectively. Research across the Las Vegas Wash has resulted in the discovery of several hundred new fossil localities. In describing the geology at these localities and geologic exposures in the wash, the SBCM has expanded the definition and mapping of the subunits of the Las Vegas Formation to include lateral facies changes outside of the park. Newly recognized faunal components include the microvertebrates *Rana* sp., *Masticophis* sp., cf. *Arizona* sp., *Marmota flaviventris*, *Neotoma* cf. *N. lepida*, and cf. *Onychomys* sp.. The list of megafauna has also been expanded to include a large bovid similar in size to *Eucerratherium*, and the first definitive fossils of *Bison antiquus* from Unit E. The density of sampling in North Las Vegas has allowed for a more detailed demographic analysis of this important fauna than was previously possible.

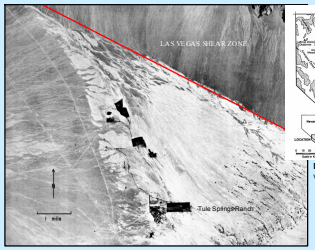


Figure 2. Overview of the Upper Las Vegas Wash, north of Las Vegas, Nevada. Photograph taken in 1964.

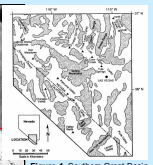


Figure 1. Southern Great Basin vicinity map (after Quade, 1986)

METHODS

Field work for this study was initiated in 2002 and is ongoing. Paleontologic localities identified during field efforts were assigned field numbers, mapped and photodocumented. Paleontologic, lithologic and stratigraphic details were described for each locality. Geographic data for each locality were recorded in the field using Global Positioning System (GPS) receivers. Detailed geologic mapping of the sites occurred subsequent to the initial discoveries in order to accurately place the fossils within the proper stratigraphic context (Figure 3). San Bernardino County Museum locality numbers and accession number are used (L prefix designation indicates Federal ownership of the specimens – all sites are on BLM land).

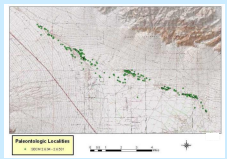


Figure 4 Paleontologic localities along the upper Las Vegas Wash

Figure 5. SBCM 2.6.74 - radiocarbon date obtained from this location.

RESULTS

A total of 526 fossil localities were discovered during the field efforts since 2002 (Figure 4). In totality, 561 sites have been identified in the upper Las Vegas Wash since 1990 by the SBCM. Recovery efforts have been initiated for many of these localities, and detailed preparation and stabilization as well as more precise identification of recovered fossils are currently underway. Previously unrecorded taxa were identified in this study (see Table 1, new records in boldface), although most of the specimens represented conformed with published faunal lists for the Tule Springs area. Radiocarbon dating results from locality SBCM 2.6.74 indicate that the specimens of *Bison antiquus*, recovered from Unit E_1, fall within the published dates for that unit, yielding a conventional radiocarbon age of 14,780 +/-40 ybp (Figure 5). A large majority of Mammuthus sites (>200) were located near previously unrecognized paleo-spring cauldrons deposits and stream channels terraces of Unit E_1 (Figure 6), consistent with observations by Mawby 1967. This locality distribution is also parallel to the inactive Las Vegas Shear Zone, suggesting that faulting influenced the discharge pattern seen during E_1 time.

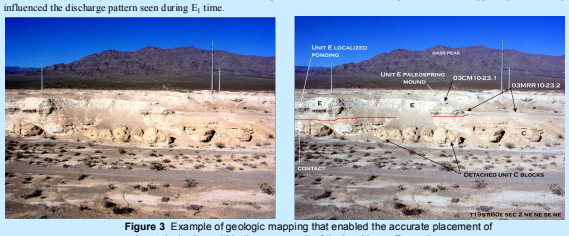


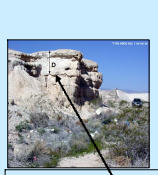
Figure 3 Example of geologic mapping that enabled the accurate placement of paleontologic sites within the proper unit of the Las Vegas Formation

BACKGROUND

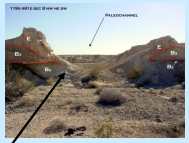
The recognition and description of paleospring deposits in the southern Great Basin (Quade, 1995; Hay, 1986)-- fine-grained sediments previously thought to be strictly lacustrine in origin--(Hubbs and Miller, 1948; Maxey and Jamesson; 1948, Snyder et al, 1964; Longwell, et al., 1965) -- has led to a wealth of data regarding paleoclimatic information of the last two major glacial periods. Paleospring deposits, as indicators of elevated water tables and increased groundwater discharge during the Pleistocene in southern Nevada, have been studied by Haynes (1967), Mifflin and Wheat (1979), Quade (1983, 1986); Quade et al (1995, 2003); Hay (1986), and Quade and Pratt (1989). Five Pleistocene stratigraphic units (A-E, in ascending stratigraphic order) and five intervening soils described from badlands exposures at the Tule Springs archaeologic site in the upper Las Vegas Wash (Haynes, 1967) as part of a large multiciplinary study in the early 1960's (Wormington and Ellis, 1967) are extrapolated into the area of our study (Quade, 1986). Quade et al (1995, 2003) documented and extended these units throughout the southern Great Basin and has continued to demonstrate paleospring discharge features and correlate these with spring recharge and climate changes in the late Quaternary in this region. Sedimentologic evidence, mollusk studies and most recently, ostracode analyses (Quade, et al 1995, 2003) have clarified the paleoenvironmental conditions and related hydrologic changes through time. Radiocarbon dating on mollusks, augmented by organic carbon, combined with $\delta^{18}O$ values from the ostracode studies have constrained the timing of the glacial episodes and clarified specific paleoenvironments of the high discharge events.

The Quaternary age Las Vegas Formation was described by Longwell et al (1965) from a series of light-colored clay and silt deposits prominently exposed along the upper Las Vegas Wash (Tule Springs), extending from Las Vegas to several miles west of Indian Springs (Figures 1, 2). The Las Vegas Wash is coincident with the Las Vegas Shear Zone. Extensional tectonics associated with the Basin and Range province of western North America helped to form the broad sedimentary basin of the Las Vegas Valley. Extension has resulted in a series of normal and strike-slip faults that cut across the region, including the inactive Las Vegas Shear Zone, a right lateral strike-slip fault. Prior to extensive urbanization of the City of Las Vegas, these exposures were present throughout the Las Vegas Valley. Previous geologic mapping has documented the extent of these units throughout the Las Vegas Valley (Longwell et al, 1965; Haynes, 1967; Matti and others, 1993; Donovan, 1996; Bell et al, 1998). The formational name "Las Vegas Formation" is used to reflect the only those deposits that crop out along the upper Las Vegas Wash. Other time-correlative spring deposit packages throughout the southern Great Basin remain unnamed at the formational level, but are assignable to by unit designations A through E. A summary of the units and the most recent age constraints is shown below in "Stratigraphy of the Las Vegas Formation"

The Las Vegas Formation, in the Tule Springs region, has yielded an assemblage of invertebrate and vertebrate fossil remains that comprise one of the best-studied late Pleistocene assemblages known from the southern Great Basin (Table 1). Although recent studies have focused on the paleoclimatic and hydrologic indicators of high discharge glacial events (spring deposits, wet meadows, seeps and streams) in the southern Great Basin, vertebrate paleontologic evidence recognized from these same high discharge lithologies has been little studied or reported upon.



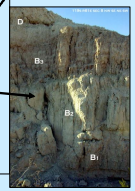
Modern Spring - Corn Creek Springs, Nevada



STRATIGRAPHY OF THE LAS VEGAS FORMATION

Unit E_2	Black mats, alluvial silts overlain by gravels
Unit E_1	14,500 to 7,400 ^{14}C ybp; spring and stream deposits
Unit D	< 26,300 to 16,400 ^{14}C ybp; extensive marsh at Tule Springs
Unit C	Alluvial sediments; Represents a drier period between B_2 and D
Unit B_3	alluvial sands
Unit B_2	190,000 to 118,000 ^{14}C ybp - pervasive green mud, high spring discharge supporting extensive springs, meadows, streams and wetlands
Unit B_1	alluvial sand and silt
Unit A	alluvial sands

Fossils known from units E_1, E_2, D and B_2



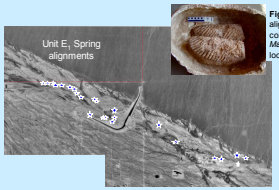


Figure 5 - spring alignments are often coincident with *Mammuthus* sp. localities

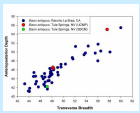


Figure 7 L3088-1 *Bison antiquus* - left magnum. Bivariate plot comparing to UCMP and NHMLAC specimens from Tule Springs

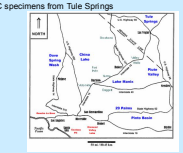


Figure 8 *Bison* localities in southern California/Mojave Desert

ACKNOWLEDGEMENTS

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TABLE 1
COMPOSITE TAXA LIST
[after Simpson, 1933, Mawby (1967), Reynolds and others (1991)

Bufo sp.	toad
Hyla sp. (large)	large tree frog
Hyla sp. (small)	small tree frog
***Rana* sp.**	**frog**
Gopherus sp.	tortoise
Sceloporus sp. cf. *S. occidentalis*	sagebrush lizard
Callisaurus sp. cf. *C. draconides*	zebra-tailed lizard
Phrynosoma sp.	horned lizard
Colubridae	nonvenomous snakes
***Masticophis* sp.**	**coachwhip**
cf. *Arizona* sp.	**glossy snake**
Mareca americana	widgeon
Aythya collaris	ring-necked duck
Aythya affinis	lesser scaup
Mergus merganser	common merganser
Teratornis merriami	extinct teratorn
Buteoninae	indeterminate soaring hawk
Fulica americana	coot
Fulica americana minor	extinct small coot
Bubo sp.	owl
Megalonyx jeffersoni	Jefferson's ground sloth
Nothrotheriops shastensis	Shasta ground sloth
Mammuthus columbi	extinct Columbian mammoth
Sylvilagus sp.	cottontail rabbit
Lepus sp.	jack rabbit
?Brachylagus idahoensis	possible pygmy rabbit
Ammospermophilus leucurus	antelope ground squirrel
Marmota flaviventris	**yellow-bellied marmot**
Thomomys bottae	Botta's pocket gopher
Dipodomys sp. (large)	large kangaroo rat
Dipodomys sp. (small)	small kangaroo rat
Perognathus sp.	pocket mouse
***Onychomys* sp.**	**grasshopper mouse**
Peromyscus sp. cf. *P. maniculatis*	deer mouse
Neotoma sp.	wood rat
Neotoma* cf. *N. lepida	**desert woodrat**
Microtus sp. cf. *M. californicus*	meadow vole
Ondatra zibethicus	muskrat
Taxidea taxus	badger
Canis latrans	coyote
Felidae cf. *Puma concolor*	puma-sized cat
?Lynx sp.	possible lynx or jaguarundi
Panthera atrox	extinct North American lion
Equus sp. (large)	extinct large horse
Equus sp. (small)	extinct small horse
Camelops sp.	extinct large camel
Odocoileus sp.	deer
?Tetrameryx sp.	extinct pronghorn
Bovidae	**large bovid**
Bison* sp. cf *B. antiquus	**extinct bison**

DISCUSSION

The detailed mapping of over 500 vertebrate paleontologic localities in the upper Las Vegas Wash proved to be an interesting challenge in terms of discerning the stratigraphy. Very little geologic investigation had been performed in this region since the 1967 work of Haynes. That very detailed study was geographically limited to the Tule Springs archaeologic investigation and the very near environs at a reconnaissance level. Our study area, falling mostly within the Gass Peak S.W. 7.5' U.S.G.S. topographic sheet, had not been mapped. The sheet immediately to the northwest, the Tule Springs Park, 7.5" sheet had (Bell and other, 1998), and proved useful. In general, there was a paucity of information with which to dovetail our work, an area that encompassed nearly 25,000 acres. It was imperative that we conduct extensive geologic mapping of the bluffs that encompass the upper Las Vegas Wash to discriminate between the various units of the Las Vegas Formation and to place the fossils in the appropriate temporal context (Figure 3). The fossil sites are located along the wash and occur throughout a deeply eroded badland topography. The units of the Las Vegas Formation, through successive periods of dissection, deflation and deposition, are inset into each other and are laterally discontinuous. The methodology that we employed to recover the maximum amount of data was more comprehensive than simply creating a geologic map in plan view, but was one that extended the detail to the third dimension by using digital photography and mapping the units directly onto the images. This allowed definitive location of all of the fossil localities in space and time. Temporal and spatial clarity of >500 fossil localities was the ultimate goal for this study, and understanding the complex geologic framework of this portion of the upper Las Vegas Wash provided us with the stratigraphic control we sought. Interestingly, Haynes, 1967 employed this same technique 43 years ago over a much smaller area. but with the same goal--stratigraphic control-- to discern that the vertebrate fossils were not contemporaneous with the archaeologic evidence at Tule Springs.

When mapping the units, it was noted that the high discharge events of unit B_2, D and E_1 are lithologically similar in that they all contain green silts and mud, as well as abundant mollusks. These lithologies result from the complex mosaic of aquatic settings, including flowing springs with or without fault influences, wet meadows, streams and wetlands. Vertebrate remains apparently are preferentially preserved in these environments mostly likely because of to increased clay and organic content and lowered oxygen content. Ancient spring deposits may also be animal traps (Haynes, 1967).

Mawby (1967) reported fossils of extinct *Bison* at two Unit B_2 localities of the Las Vegas Formation, but not from any of the later fossil-bearing units (D and E_1). Examination of existing collections at UC Berkeley confirmed *Bison* from Tule Springs from unit B_2. In the Mojave Desert, Pleistocene fossils of *Bison* are relatively common at localities younger than ~20,000 ybp (Scott and Cox, 2002, Figure 8). It was anticipated that *Bison* should occur in the younger units of the Las Vegas Formation. By our study, we have undisputed confirmation of *Bison* from Unit E_1 and the youngest reliably dated record from the Mojave Desert/southern Great Basin. Radiocarbon dating (14,780 +/- 40 ybp) confirms we are within the reported range of unit E_1 in the southern Great Basin (Figure 7).

Vertebrate faunas in deposits from the southern Great Basin high discharge events demand synthetic reporting and treatment. This study is part of of an effort to incorporate these records into the larger paleoclimatic and hydrologic framework of the last two glacial maxima so well documented by Quade et al (1995, 2003).

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